I – **Problem Statement Title**

Pre-stressed Structural System for Smart California Bridges
(PRESS-Bridge)
Exploratory Study

II – **Research Problem Statement**

Question: How to design and build a new type highway overpass bridge using pre-cast, pre-stressed structural elements and connection, made using advanced materials, equipped with seismic response modification devices and instrumented using state-of-the-art sensors to economically achieve a new level of seismic safety with a high level of confidence?

Conduct an exploratory study and workshops to examine the possibilities to develop a new type of highway overpass bridges with the goal to economically achieve a higher level of seismic safety.

III – **Objective**

STAP Roadmap Outcome: 1#2, 2#1, 3#2, and 8#1.

The objective of this exploratory study is to examine the possibilities to design, develop and implement a new, more economical and more seismically safe structural system for highway overpass bridges. This bridge system may comprise pre-cast, possibly pre-stressed, structural elements made using new advanced materials, connected using new connections featuring seismic response modification devices and sensors to enable evaluation of bridge state. New computer models, calibrated to element and system tests, may be a part of the new bridge system. This exploratory study should address and evaluate the benefits and deployment potential of such new highway overpass bridge system. The consequence of this study may be a focused series of projects to develop and validate the new highway overpass bridge structural system.

IV – **Background**

Nearly eighty percent of California highway bridges are cast-in-place post-tensioned concrete bridges designed and developed using engineering techniques of the 1980's and 1990's. It may be beneficial to explore developing a new structural system for highway overpass bridges that integrates advances in new materials, sensors, pre-cast element construction, special structural connections, sensors and seismic response modification devices, and modern analysis techniques. Significant progress has been made along each one of these directions separately, in a bottom-up fashion. This project is an exploratory study to investigate the

opportunities integrate these new engineering methods, technologies and materials, and develop a new structural system starting from the top down such that it is more economical and offers higher confidence in its seismic safety.

V – Statement of Urgency, Benefits, and Expected Return on Investment

The proposed exploratory study to investigate the use of new engineering technologies to develop a new more economical and more seismically safe bridge structural system is urgent for two reasons: first, the development of new engineering techniques, analysis methods and performance-based design and evaluation procedures has reached the state when then can be integrated to produce a better structural system; and second, the momentum provided by the design and construction of the new East Bay Bridge (using pre-cast post-tensioned elements) is here. There is a substantial economic incentive to develop a new bridge type using advanced materials and sensor systems: this bridge may be less expensive to build and less expensive to maintain over time. There is, also, an opportunity to precisely define the seismic performance of such new bridge type in accordance with the public expectations of adequate safety and acceptable level of cost. Conducting an exploratory study on this topic is the best way for Caltrans to evaluate these promising options with a small initial investment, and then choose the ones with the best deployment potential.

VI – Related Research

Substantial, but separate, efforts on developing bridge components using new materials, on using pre-cast bridge elements, on bridge instrumentation and monitoring, bridge seismic response modification devices, and bridge fragility analysis.

VII – Deployment Potential

Conclusions from the proposed exploratory study should provide Caltrans with a clear picture of which new engineering technologies, material and design methods may be deployed and when. Some of the findings may need to immediate deployment of mature engineering technologies, while other promising methods may need to be validated in follow-up projects.